

# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Power-driven Fastener Tools

We, INGERSOLL-RAND COMPANY, a corporation organized and existing under the laws of the State of New Jersey, United States of America, located at 11 Broadway, New York

5 4, State of New York, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and  
10 by the following statement:—

This invention relates to tools and more particularly to fastener driving tools.

Presently known power tools, such as power screw drivers, employ a "Y"-type connecting joint between a screw feed conduit and the housing of the tool to convey the fasteners into the finder of the tool in front of the driving bit of the tool. This construction is undesirable since the driving bit must be retracted a substantial distance to permit the passage of the fastener into the finder. This reciprocation is undesirable since it requires an excessive amount of useless movement or "dead stroke" of the tool. To minimize the problems involving the guidance of the fasteners into the finder, the "Y"-type connection is constructed and arranged so that the entry passage axis is located at as small an acute angle as possible  
20 with respect to the longitudinal axis of the bit. This latter requirement further aggravates the amount of useless movement of the bit required to permit the passage of the fastener into the finder.

25 30 35 The tool according to the invention is to be provided with an escapement mechanism at the finder to insure entry of the fasteners singly into the finder. This mechanism is to be relatively simple and reliable.

40 Also, a means is to be provided to prevent the fasteners from being forced back from the finder jaws at the start of the driving operation of the tool.

Accordingly, it is an object of this inven-

tion to provide a fastener driving tool having a fastener-feeding mechanism wherein useless or "dead stroke" movement of the bit is minimal. 45

Another object of the present invention is to provide a fastener driving tool having a fastener-feeding mechanism which is capable of feeding fasteners of a greater range of different sizes than presently known mechanisms. 50

A further object of this invention is to provide a fastener driving tool having a fastener-feeding mechanism wherein a separate means to prevent the fastener from being forced out of engagement with the finder jaws at the start of the driving of the tool is obviated. 55

In brief, the objects of this invention are accomplished in a fastener driving tool having a fastener-feeding mechanism by mounting the fastener driving bit of the tool on a flexible shaft and arranging it to be forced laterally out of axial alignment with the tool by the feeding of a fastener through the screw feed conduit, thus uncovering the discharge end of the conduit whereby a fastener can pass freely from the conduit into the finder of the tool without interference by the tool bit. 60

In one embodiment of the invention the tool bit is moved laterally under the urging of the pressurized fluid in the fastener-feeding conduit, which fluid impinges the surface of a tubular member containing the tool bit covering the entrance port. 70

In another embodiment of the invention the tubular member carrying the tool bit is provided with a canted piston which, when subjected to the pressurized fluid, causes the tubular member to move laterally and uncover the entrance port. 80

The invention will be more fully understood from the following detailed description thereof when considered in connection with

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the accompanying drawings wherein two embodiments of the invention are illustrated by way of example and in which:

5 Fig. 1 is a fragmentary, side elevational view of a tool having a fastener-feeding mechanism according to one embodiment of this invention;

10 Fig. 2 is a longitudinal, sectional view taken along line 2—2 of Fig. 1;

15 Fig. 3 is a perspective view, with parts broken away, showing the fastener-feeding mechanism shown in Fig. 1;

20 Fig. 4 is an exploded, perspective view, similar to Fig. 3, having a greater number of parts broken away for illustrative purposes;

25 Fig. 5 is a perspective view, similar to Fig. 3, with other parts broken away for purposes of illustration;

30 Fig. 6 is a schematic and vertical section of the tool showing the fastener driving bit forced to tilt sideways to uncover the end of the fastener feed tube during the feeding of a fastener;

35 Fig. 7 is another schematic and vertical section of the tool taken at right angles relative to Fig. 6 and showing a fastener being held by the fastener-holding jaws in position for being driven;

40 Fig. 8 is a schematic view similar to Fig. 7 showing the tool as the fastener is released by the jaws and driven "home"; and

45 Fig. 9 is a view, similar to Fig. 2, showing another embodiment of the present invention.

50 Referring now to the drawings and particularly to Figs. 1 to 8, the reference numeral 10 generally designates a fastener-feeding and holding mechanism according to this invention, which mechanism is shown connected, for purposes of illustration, to a screw fastener driving tool 11.

55 As best shown in Figs. 1, 2, and, power tool 11 comprises a housing or casing 12 in which is disposed a motor (not shown) connected to rotatively drive a bit holder 14. A tubular shroud 15 is coextensive with casing 12 and supports, for slidable movement relative to the casing, a fastener feed tube 16.

60 Fastener-feeding and holding device 10, as best shown in Figs. 1 to 5, includes a housing extension 19 which is coaxially secured to casing 12. A finder housing 20 is provided with a cylindrical bore 21 in the rear end portion 22 thereof, which bore is dimensioned to slidably receive housing extension 19 therein so that the finder housing is supported for axial movement relative to the housing extension 19. As best shown in Figs. 1 and 3, finder housing 20 is provided

65 with a slot 23 extending from one side to the other and from rear end portion 22 to the distal end portion 24 so that the finder housing is bifurcated and thereby has a pair of finger portions 25 and 26. An oval-shaped fastener entrance port 27 is provided in finger 26 to

receive the discharge end portion of fastener feed tube 16 (See Fig. 4). A pair of jaws 28 and 29 is pivotally disposed in slot 23 by pins 30 which extend through the registered openings in fingers 25 and 26 and jaws 28 and 29. Jaws 28 and 29 are biased in a closed position by springs 31 which are secured in openings 3 in end portion 22 by set screws 33 and which project into a groove 34 in each of the jaws 28 and 29. The jaws 28 and 29 have complementary-shaped, juxtaposed gripping faces 35 and 36, respectively, which define therebetween a fastener-receiving and holding orifice.

70 Disposed in slot 23 between jaws 28 and 29 is an elongated bit guide 38 which comprises in cross section a substantially square portion 39 and an integral cylindrical portion 40. The end of cylindrical portion 40 is provided with an enlarged flanged end 41. Flanged end 41 is dimensioned to fit loosely within housing extension 19 so that bit guide 38 can tilt laterally out of axial alignment with the tool as illustrated in Figs. 4 and 6. A snap ring 45 serves to retain bit guide 38 within housing extension 19 by abutting flanged end 41. Bit guide 38 has a cylindrical axial bore 42 extending therethrough, which bore is adapted to receive a fastener-engaging member or bit 43. Bit 43, as illustrated, may be a screw driver bit which is secured at one end to the end of a flexible shaft or shank member 44. The rear end portion of shank member 44 is adapted to fit within and to be rotatively secured to bit holder 14. Bit guide 38 is biased in a forward direction by a coil spring 46 which is disposed within housing extension 19 and in abutment at one end against an end wall 19A and flanged end 41 of bit guide 38.

75 To permit lateral, pivotal movement of bit guide 38 and bit 43 in a directional away from entrance port 27, finger 5 is provided with a rectangular-shaped notch 47. Notch 47 is dimensioned so as to permit movement of bit guide 38 therethrough, as is illustrated in Fig. 4. Spring 46, upon pivotal movement of bit guide 38, is loaded and thereby urges bit guide 38 to return to a position in which it covers entrance port 27 and aligns with the fastener-receiving and holding orifice defined by jaws 28 and 29.

80 To prevent lateral movement of bit guide 38 while the power tool is in the fastener-rundown position shown in Fig. 5, each of the jaws 28 and 29 is provided with lugs or projections 28A and 29A, respectively, which engage shoulders or rabbets 38A and 38B, respectively, formed on bit guide 38. Projections 28A and 29A are so dimensioned that they only engage their respective shoulders 38A and 38B when pivoted to an open position as is shown in Figs. 5 and 8.

85 The projections 28A and 29A on the jaws 28 and 29 also serve to prevent the jaws

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28 and 29 from opening during the feeding of a screw or other fastener. When the bit guide 38 is in its normal position of axial alignment with the tool, the rabbets 38A and 38B receive the jaw projections 28A and 29B when the jaws 28 and 29 open, as shown in Figs. 5 and 8. However, the tilting of the bit guide 38 to uncover the feed tube 16, as shown in Figs. 4 and 6 swings the sides 10 of the bit guide 38 between the jaw projections 28A and 29A, thus engaging and preventing the jaws 28 and 29 from opening.

In other words, the tilting of the bit guide 38 to the fastener feeding position shown in Fig. 6 swings the rabbets 38A and 38B out of position to receive the jaw projections 28A and 29A, so that the jaws 28 and 29 are locked in closed position. This feature prevents the jaws 28 and 29 from opening during the feeding of a fastener. Opening the jaws 28 and 29 at this time would allow the fastener to escape from the gripping faces 35 and 36 of the jaws 28 and 29 and be "shot" from the tool.

In the operation of fastener-feeding and holding device 10, a fastener 50 (Fig. 2) is delivered from a source of fasteners along with the pressurized fluid, such as air, through an escapement mechanism (not shown) into a flexible portion (not shown) of feed tube 16. The pressurized fluid acts on the surface of bit guide 38 covering entrance port 27 and thereby forces the bit guide 38 to tilt laterally into notch 47 of finger 25, as shown in Fig. 6. The bit guide 38 is tilted sufficiently to uncover the port 27 and permit fastener 50 to pass through entrance port 27 into the space between jaws 28 and 29 and into the fastener-receiving and holding orifice defined by gripping faces 35 and 36 of jaws 28 and 29, as shown in Fig. 7. Thereafter, the tool is moved toward a working surface 52 and into engagement with the latter, as shown in Fig. 8, so that the entire fastener-feeding and holding mechanism 10 is moved rearwardly relative to power tool 11 and bit 43. Such movement brings bit 43 into engagement with the fastener which is prevented from moving rearwardly out of the receiving and holding orifice by the abutment of the forward end of bit guide 38 against the fastener. Continued axial movement of the fastener-feeding and holding mechanism 10 relative to bit 43 causes jaws 28 and 29 to be cammed apart by tapered end edges 51 of bit guide 38. The bit 43 is rotated by the power tool motor (not shown) through bit holder 14 and flexible shank 44 to thereby rotatively drive the fastener. When the fastener is secured in the working surface 52 to a predetermined extent, an escapement mechanism (not shown) is energized by a fluid signal to allow another fastener to be positioned for the next fastening operation.

In Fig. 9 is shown another embodiment of the present invention, which embodiment differs from the embodiment shown in Figs. 1 to 5 in that bit guide 38 is positively displaced rather than displaced coincidental with the pressurized fluid flowing through fastener feed tube 16. In view of the similarity of construction between the two embodiments, parts of the embodiment shown in Fig. 9 corresponding to or similar to the parts of the embodiment shown in Figs. 1 to 5 will be designated by the same reference number but with the suffix Z added thereto.

As shown in Fig. 9, the feeding and holding mechanism 10Z has a bit guide 38Z having a canted piston head 60 in place of flanged end 41. A pressurized fluid supply line 61 is attached at one end to housing extension 19Z to communicate with the interior of the housing extension and at the opposite end with a suitable source of pressurized fluid (not shown). Spring 146 of the embodiment of Figs. 1 to 5 has been replaced by a leaf spring 62 which is secured to end portion 22Z so as to extend into notch 47Z and into engagement with bit guide 38Z to bias the latter in a direction to close entrance port 27Z.

The opposite end (not shown) of line 61 may be connected to the escapement mechanism (not shown) so that, when the escapement mechanism is actuated to introduce a fastener into feed tube 16Z, the pressurized fluid is introduced through line 61 into the interior of housing extension 19Z. When the pressurized fluid, such as compressed air, is introduced into housing extension 19Z, the force exerted by the fluid upon piston head 60 causes bit guide 38Z to be laterally displaced against the force of leaf spring 62. Displacement of bit guide 38Z, as in the embodiment described in Figs. 1 to 5, uncovers entrance port 27Z to thereby permit passage of a fastener into the fastener-holding orifice defined between jaws 28Z and 29Z (only one of which is shown in Fig. 9).

It is believed now readily apparent that the present invention provides a fastener-feeding and holding mechanism wherein useless or "dead" axial movement of the bit is eliminated. It is a mechanism wherein a fastener cannot be dislodged from the fastener-holding jaws until after firm engagement of the bit with the fastener is achieved.

Although only two embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the arrangement of parts without departing from the scope of the invention, as set out in the following claims.

WHAT WE CLAIM IS:—

1. A fastener-driving tool having a driven means mounted for rotation in a housing and connected to a motor, comprising a fastener-holding mechanism to releasably hold a

fastener in a position to be driven, a fastener-driving bit located in said housing to drive said fastener releasably held in said fastener-holding mechanism, a fastener-feeding mechanism for feeding fasteners to said fastener-holding mechanism and having an outlet normally closed by said fastener-driving bit, and yieldable means connecting said fastener-driving bit to said motor to be driven thereby and allowing said bit to be tilted sideways so as to uncover said outlet of said fastener-feeding mechanism during the feeding of a fastener.

2. The tool according to Claim 1, wherein said fastener-feeding and holding mechanisms include a finder mounted on said housing and having an axial bore and at least a pair of jaws on either side of said bore for engaging a fastener, said finder having an entrance port communicating with said bore, a conduit connected at one end to a source of pressurized fluid and to a source of fasteners and at the opposite end communicating with the bore at the entrance port in said finder, a tubular member disposed in the bore of the finder and substantially covering said entrance port, said bit being disposed in said tubular member, and means for causing said tubular member to be displaced away from said entrance port and to allow passage of a fastener from said conduit means into said bore and toward the entrance port to substantially close said entrance port.

3. The tool according to Claim 1 and 2, wherein said yieldable connecting means includes a flexible shaft to effect rotation of the bit and conjoined displacement of the bit with the tubular member.

4. The tool according to Claims 1 and 2 wherein means is provided for locking said fastener-holding mechanism against release during that period that said bit is tilted to uncover the outlet of said fastener-feeding mechanism.

5. The tool according to Claim 2, wherein said finder is bifurcated to define two fingers and said pair of jaws is pivotally mounted between said fingers.

6. The tool according to Claim 2, wherein said tubular member is substantially square in cross-section and has a circular interior configuration.

7. The tool according to Claim 2, wherein a spring is provided for biasing said tubular member in a direction toward the entrance port.

8. The tool according to Claim 2, including a tubular housing extension connected to said housing to define a cylinder in which one end of said tubular member is disposed.

9. The tool according to Claim 8, wherein spring means is disposed in said housing extension to bias said tubular member toward said entrance port.

10. The tool according to Claim 2, wherein said jaws are pivotally mounted on said finder on opposite sides of said bore for holding said fastener.

11. The tool according to Claim 2, wherein a slot is provided in said finder on the opposite side of the tubular member from said entrance port to permit lateral displacement of the tubular member in a direction away from said entrance port when so urged by the pressurized fluid in said conduit.

12. The tool according to Claim 2, wherein biasing means is provided for urging the tubular member in a direction to substantially cover said entrance port.

13. The tool according to Claims 8 and 12, wherein said biasing means is a spring disposed in said housing extension and bearing against the end of the tubular member in said housing extension.

14. The tool according to Claim 12, wherein said biasing means is a leaf spring secured at one end to said finder and with the opposite end bearing against said tubular member.

15. The tool according to Claim 5, wherein said jaws have lugs which engage the tubular member when the jaws are pivoted to an open position to thereby prevent lateral displacement of the tubular member.

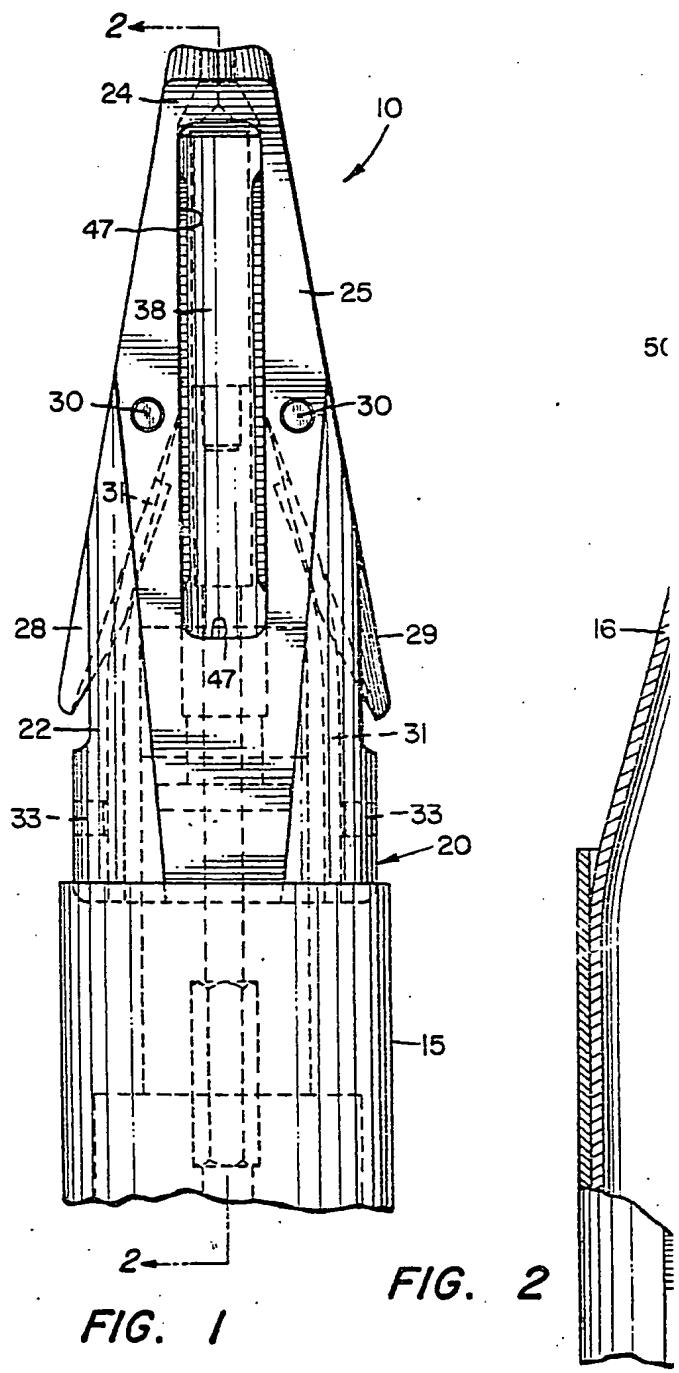
16. The tool according to Claim 2, wherein in said tubular member is provided at its distal end with cam means for actuating said pair of jaws to release a fastener held thereby.

17. The tool according to Claims 2 and 8, wherein pressurized fluid conduit means is provided for conducting pressurized fluid to said housing extension and thereby effecting lateral displacement of the tubular member under the force of said fluid pressure.

18. The tool according to Claim 17, wherein in said one end of said tubular member is in the form of a canted piston disposed within said housing extension to effect lateral displacement of the tubular member when said pressurized fluid exerts pressure on said canted piston.

19. Fastener-driving tools substantially as described with reference to the accompanying drawings.

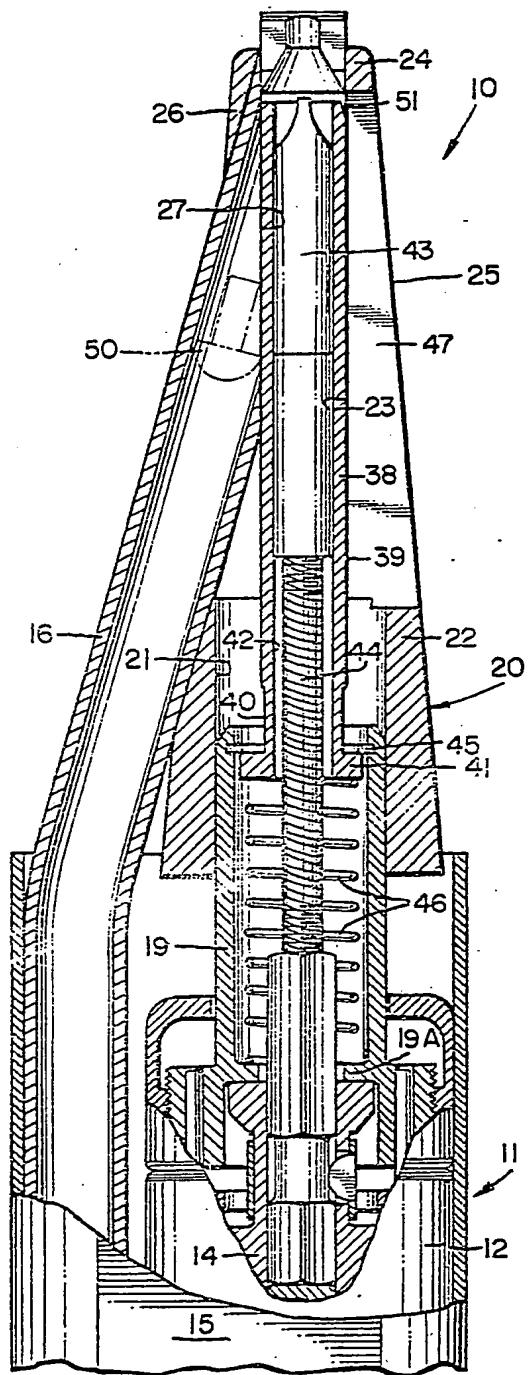
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Sheet 1*

G. 2



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Sheet 1

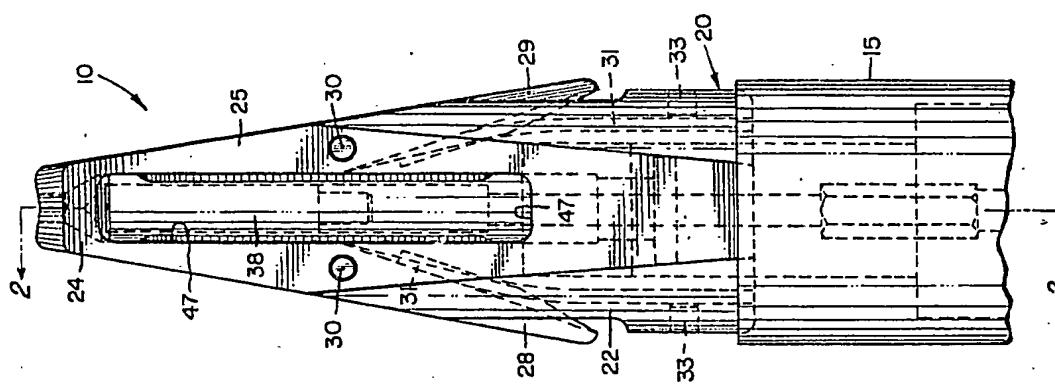
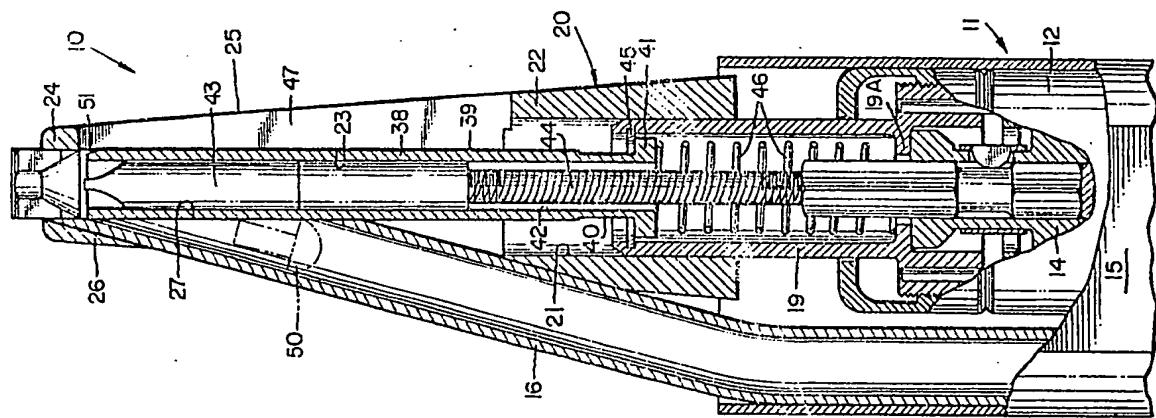
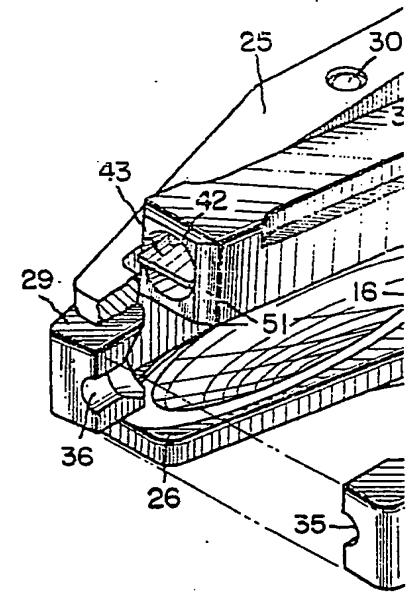
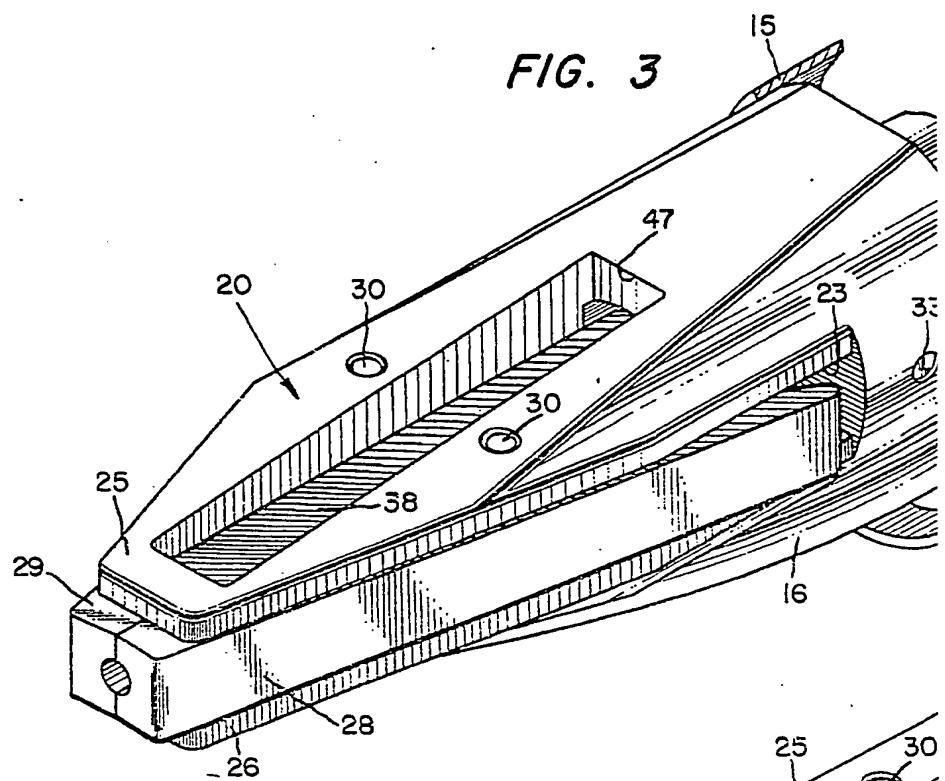


FIG. 2

FIG. 1

*FIG. 3*



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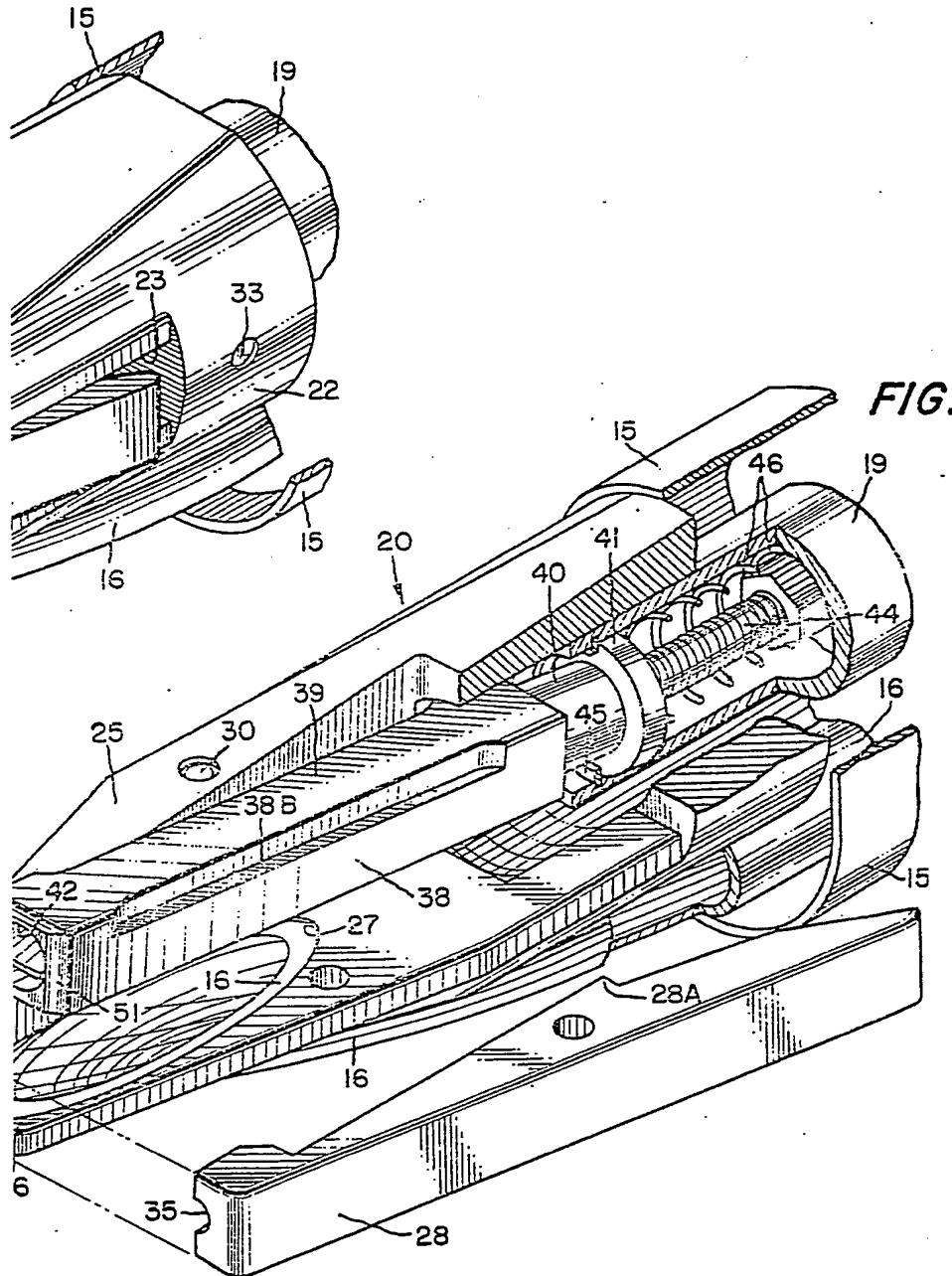
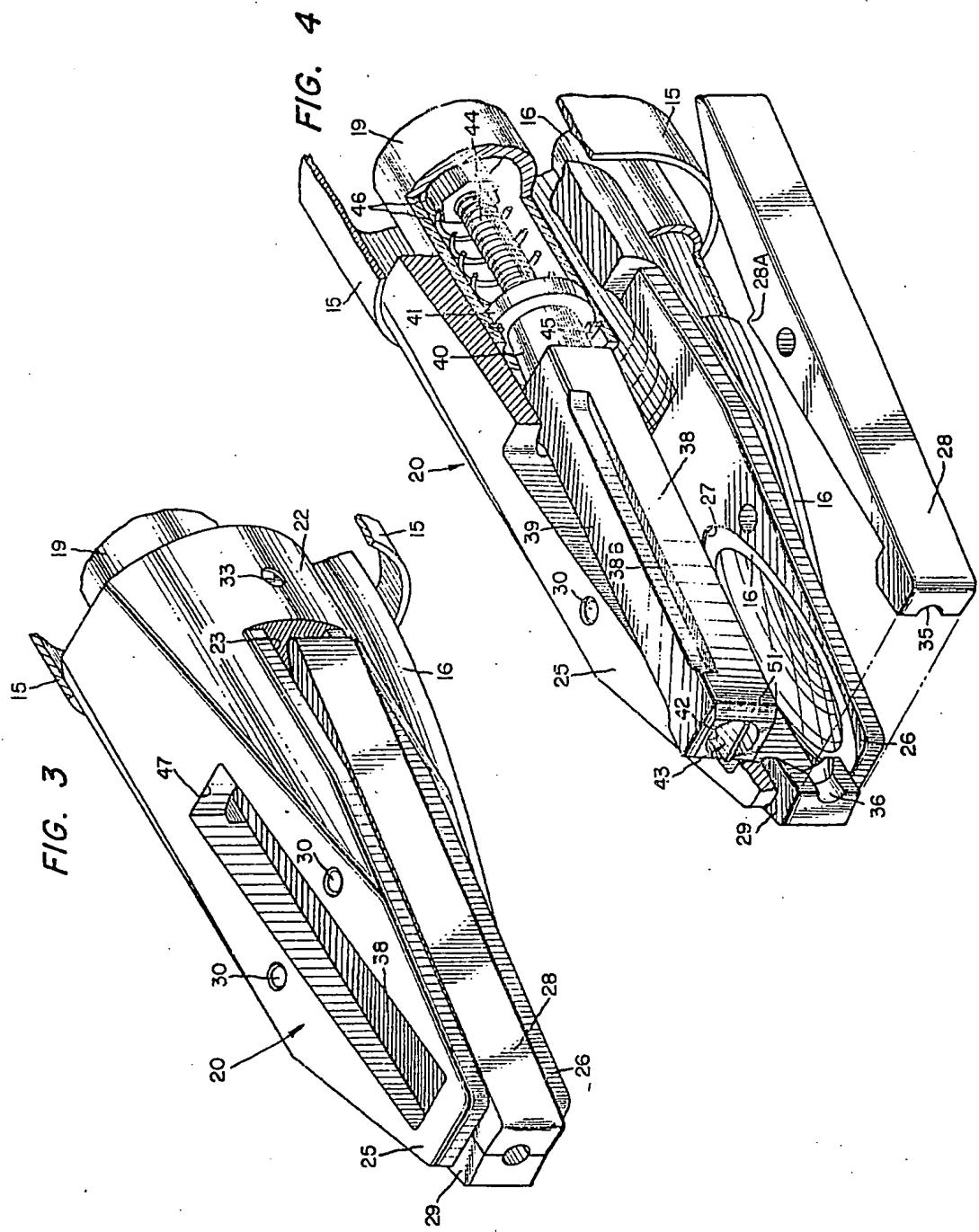


FIG. 4

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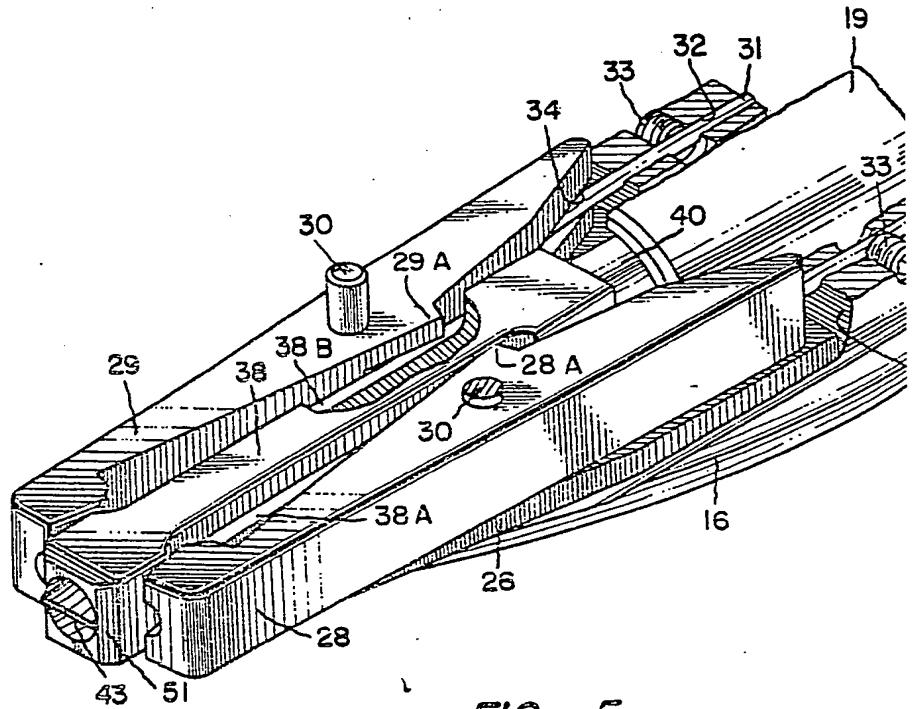


FIG. 5

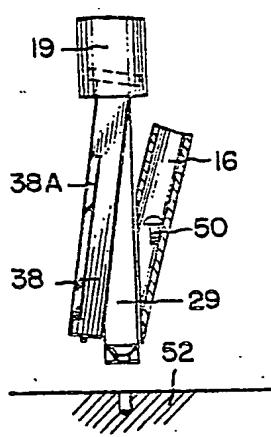


FIG. 6

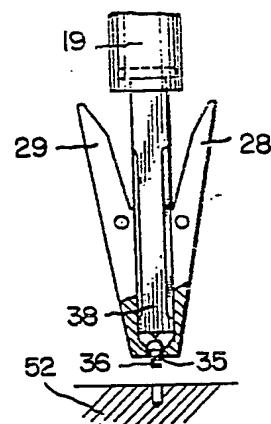
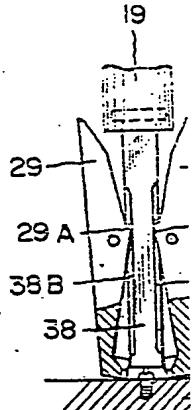


FIG. 7



*FIG.*

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Sheet 3

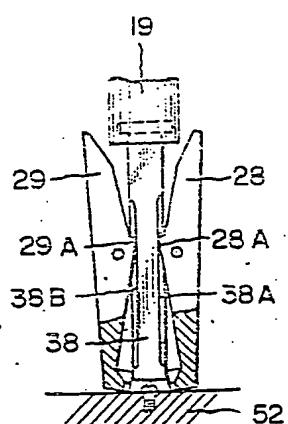
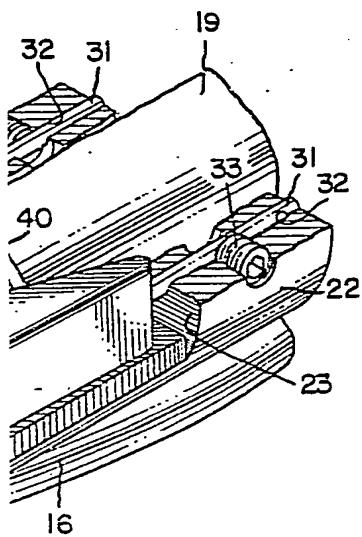


FIG. 8

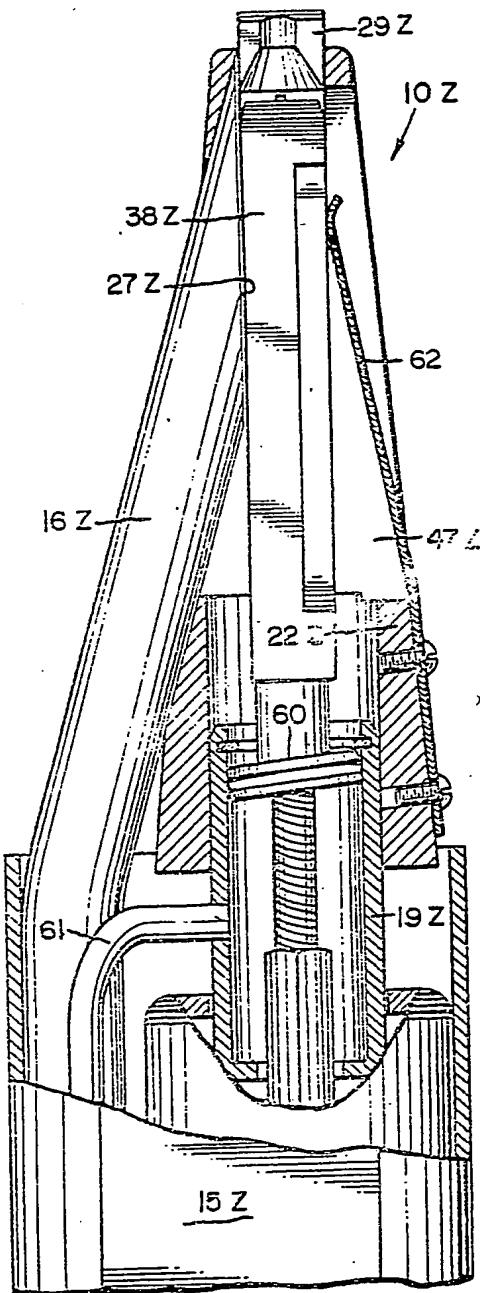


FIG. 9

